1. Evaluate the following integrals using the method of integration by substitution:
   (a) \( \int e^{3x} \, dx \)
   (b) \( \int xe^{x^2} \, dx \)
   (c) \( \int \frac{x^2}{1+x^3} \, dx \)
   (d) \( \int \frac{(\ln x)^3}{x} \, dx \)
   (e) \( \int 6 \cos^5 \theta \sin \theta \, d\theta \)

2. Evaluate the following indefinite integrals:
   (a) \( \int \cos \theta (\sin \theta + \pi)^6 \, d\theta \)
   (b) \( \int \sqrt{\cos 4t} \sin 4t \, dt \)
   (c) \( \int x \sin(x^2) \, dx \)
   (d) \( \int x(x+1)^7 \, dx \)
   (e) \( \int 4x^2 e^{x^4} + e^{x^4} + x \, dx \)

3. Evaluate the following definite integrals:
   (a) \( \int_0^{12} \sqrt{x+4} \, dx \)
   (b) \( \int_2^3 \frac{x-3}{2x^2-3x+1} \, dx \)
   (c) \( \int_0^3 x^2 \sqrt{x+1} \, dx \)
   (d) \( \int_0^\pi \sin \theta e^{\cos \theta} \, d\theta \)

4. Find the area under the graph of \( y = \cos \left( \frac{\theta}{2} \right) \sin^2 \left( \frac{\theta}{2} \right) \) between \( \theta = 0 \) and \( \theta = \pi \).

5. Explain why
   \( \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \cos \theta \, d\theta = 2 \int_0^{\frac{\pi}{2}} \cos \theta \, d\theta = 2 \),
   and
   \( \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin \theta \, d\theta = 0 \).

6. Evaluate the indefinite integral
   \( \int 3x^2(x^3 - 1) \, dx \)
   using two methods:
   (a) Expand the polynomial inside the integral and then evaluate,
(b) Use integration by substitution.
(c) Do your answers agree? Why or why not?

7. Find the total area bound by the following curves:
   (a) \( y = x \) and \( y = x^2 \)
   (b) \( y = 9 \) and \( y = x^2 \)
   (c) \( y = x^3 + x^2 - 2x \) and the \( x \)-axis
   (d) \( y = x\sqrt{x^2 - 1}, \) \( x = 2, \) \( x = 3 \) and the \( x \)-axis

8. Evaluate the following integrals using the method of integration by partial fractions:
   (a) \( \int \frac{2 - x}{x^2 - 5x} \, dx \)
   (b) \( \int \frac{2x + 3}{x^2 - 9} \, dx \)
   (c) \( \int \frac{3x + 11}{x^2 - x - 6} \, dx \)
   (d) \( \int \frac{x^2 - x + 6}{(x - 4)^2(x + 4)} \, dx \)
   (e) \( \int \frac{x^2 - x + 6}{(x - 1)(x^2 + 4)} \, dx \)
   (f) \( \int \frac{x^2 + 4}{3x^3 + 4x^2 - 4x} \, dx \)
   (g) \( \int_3^5 \frac{3}{x^2 - 4} \, dx \)
   (h) \( \int_2^3 \frac{3x - 1}{x^2 + 6x - 7} \, dx \)

9. For each of the following functions and intervals, find the volume of the solid obtained by rotating the total region bound by the graph and the \( x \)-axis on the given interval about the \( x \)-axis.
   (a) \( y = x, \) \( 0 \leq x \leq 2 \)
   (b) \( y = \sqrt{x}, \) \( 1 \leq x \leq 4 \)
   (c) \( y = e^x, \) \( 0 \leq x \leq 2 \)
   (d) \( y = x, \) \( -3 \leq x \leq 3 \)
   (e) \( y = x^2 - 1, \) \( 0 \leq x \leq 2 \)

10. The rate at which the human body eliminates an experimental drug is modelled by the equation
    \[ E(t) = 10te^{-t^2}, \]
    where \( t \) is measured in days and \( E \) is measured in mg. If the initial dose is 5mg, how much of the drug remains after two and a half days?